

Claims

What is claimed:

1. An additive concentrate, comprising:

- a) an extreme pressure compound comprising a sulfur-containing compound;
- b) an antiwear compound comprising a phosphorous-containing compound;
- c) a friction modifying compound comprising an alkylene amine compound;
- d) a dispersant compound containing basic nitrogen; and
- e) a diluent oil,

wherein any of compounds a), b), c) and d) can be the same or different compounds.

2. The additive concentrate according to claim 1, wherein the dispersant compound comprises a polyolefin amide compound.

3. The additive concentrate according to claim 1, wherein the dispersant compound comprises a polyolefin amide alkylene amine.

4. The additive concentrate according to claim 1, wherein the alkylene amine compound comprises an N-aliphatic hydrocarbyl-substituted trimethylenediamine wherein the N-aliphatic hydrocarbyl-substituent comprises at least one straight chain aliphatic hydrocarbyl group free of acetylenic unsaturation and having about 14 to about 20 carbon atoms.

5. The additive concentrate according to claim 1, wherein the alkylene amine compound is selected from the group consisting of N-oleyl-trimethylene diamine, N-tallow-trimethylene diamine, N-coco-trimethylene diamine, and combinations thereof.

6. The additive concentrate according to claim 1, comprising about 15 to about 40 wt.% extreme pressure compound comprising a sulfur-containing compound; about 10 to about 40 wt% antiwear compound comprising a phosphorous-containing compound, which is a different compound than the sulfur-containing compound; about 2 to about 25 wt% friction modifying alkylene amine compound; about 15 to about 60 wt% dispersant compound containing basic nitrogen; and a minor amount of diluent oil.

7. The additive concentrate according to claim 1, wherein compound a) is present in an amount sufficient to provide at least about 1,000 ppm sulfur and the compound b) is present in an amount sufficient to provide about 100 to about 500 ppm phosphorus to the concentrate.
8. The additive concentrate according to claim 1, wherein the antiwear compound comprises a phosphorus-containing anti-wear compound selected from the group consisting of oil-soluble amine salts of a phosphoric ester, and reaction products of dicyclopentadiene and thiophosphoric acid.
9. The additive concentrate according to claim 1, wherein the extreme-pressure compound comprises a sulfur-organic compound including a sulfur-containing species bound directly to carbon or to more sulfur.
10. The additive concentrate according to claim 1, wherein the sulfur-containing compound and the phosphorus-containing compound are the same chemical compound which contains both sulfur and phosphorus.
11. The additive concentrate according to claim 1, wherein the sulfur-containing compound and the phosphorus-containing compound are different chemical compounds from each other.
12. The additive concentrate according to claim 1, further comprising an ashless dispersant.
13. The additive concentrate according to claim 1, essentially devoid of an ashless dispersant.
14. A composition, comprising:
 - a) an extreme pressure compound comprising a sulfur-containing compound;
 - b) an antiwear compound comprising a phosphorous-containing compound;
 - c) a friction modifying compound comprising an alkylene amine compound;
 - d) a dispersant compound containing basic nitrogen; and
 - e) base oil,wherein any of compounds a), b), c) and d) can be the same or different compounds.
15. The composition according to claim 14, wherein the dispersant compound comprises a polyolefin amide compound.
16. The composition according to claim 14, wherein the dispersant compound comprises a polyolefin amide alkylene amine.

17. The composition according to claim 14, wherein the alkylene amine compound comprises a N-aliphatic hydrocarbyl-substituted trimethylenediamine wherein the N-aliphatic hydrocarbyl-substituent comprises at least one straight chain aliphatic hydrocarbyl group free of acetylenic unsaturation and having about 14 to about 20 carbon atoms.
18. The composition according to claim 14, wherein the alkylene amine compound is selected from the group consisting of N-oleyl-trimethylene diamine, N-tallow-trimethylene diamine, N-coco-trimethylene diamine, and combinations thereof.
19. The composition according to claim 14, comprising about 0.5 to about 2.5 wt% extreme pressure compound comprising a sulfur-containing compound; about 0.2 to about 2.0 wt% antiwear compound comprising a phosphorous-containing compound, which is a different compound from the sulfur-containing compound; about 0.1 to about 1.0 wt% friction modifying alkylene amine compound; about 0.5 to about 3.5 wt% dispersant compound containing basic nitrogen; and a major amount of base oil.
20. The composition according to claim 14, wherein compound a) is present in an amount sufficient to provide at least about 1,000 ppm sulfur and the compound b) is present in an amount sufficient to provide about 100 to about 500 ppm phosphorus to the concentrate.
21. The composition according to claim 14, wherein the base oil has a viscosity in the range of SAE 50 to SAE 250.
22. The composition according to claim 14, wherein the base oil has a viscosity in the range of SAE 70W to SAE 140.
23. The composition according to claim 14, wherein the antiwear compound comprises a phosphorus-containing anti-wear compound selected from the group consisting of oil-soluble amine salts of a phosphoric ester, and reaction products of dicyclopentadiene and thiophosphoric acid.
24. The composition according to claim 14, wherein the extreme-pressure compound comprises a sulfur-organic compound including a sulfur-containing species bound directly to carbon or to more sulfur.

25. The composition according to claim 14, wherein the extreme-pressure compound comprises a metal-free sulfur-containing extreme-pressure agent selected from the group consisting of sulfurized olefin, and polysulfide composed of one or more groups represented by the formula $R_a-S_x-R_b$ where R_a and R_b are hydrocarbyl groups each of which contains 3 to 18 carbon atoms and x is in the range of from 2 to 8.
26. The composition according to claim 14, wherein the sulfur-containing compound and the phosphorus-containing compound are the same chemical compound which contains both sulfur and phosphorus.
27. A method of manufacturing a composition comprising blending a) base oil; b) an extreme pressure compound comprising a sulfur-containing compound; c) an antiwear compound comprising a phosphorous-containing compound that is the same compound or a different compound as the sulfur-containing compound; d) a friction modifying compound comprising an alkylene amine friction modifier; and e) a dispersant compound containing basic nitrogen.
28. A method of lubricating a gear comprising using as the lubricant for said gear a composition according to claim 14.
29. A lubed gear-box comprising a gear within a gear-box lubricated according to the method of claim 28.
30. A wind turbine gear assembly lubricated with a composition according to claim 14.
31. A method of lubricating a wind turbine gear assembly comprising using as the lubricant for said gear assembly a composition according to claim 14.